

What Is Claimed Is:

1. A Raman spectroscopy system comprising:

a laser source for providing a laser beam;

5 an optical probe assembly comprising:

a photonic crystal light guide for receiving the laser beam from said laser source and for directing the laser beam toward a specimen of selected material;

10 a lens for receiving the laser beam in said light guide and directing the beam onto the specimen, and for receiving reflected light from the specimen and directing the reflected light back through said light guide; and

15 a dichroic beam splitter for directing a portion of the reflected beam out of said optical probe assembly; and

an optical spectrum analyzer for receiving the portion of the reflected beam and for exhibiting a  
20 Raman signature of the specimen.

2. The system in accordance with claim 1 wherein said light guide comprises no more than one hollow photonic bandgap fiber waveguide.

5 3. The system in accordance with claim 2 wherein said light guide comprises glass cladding.

10 4. The system in accordance with claim 3 wherein said light guide further comprises a flexible protective sheath disposed around the light guide.

5. The system in accordance with claim 2 wherein said hollow photonic fiber is filled with gas.

15 6. The system in accordance with claim 5 wherein said gas is air.

20 7. The system in accordance with claim 5 wherein said gas comprises a known Raman signature, and wherein the Raman signature of the gas is used to calibrate said spectrum analyzer.

8. The system in accordance with claim 5 wherein the specimen is a gas, and wherein said gas of said photonic fiber is configured to increase interaction length of the gas the specimen.

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9. The system in accordance with claim 1 wherein the portion of the reflected beam comprises the Raman signature portion of the beam and said beam splitter is adapted to spatially separate the Raman signature of the specimen from the reflected beam and to direct the portion of the reflected beam to said optical specimen analyzer.

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10. The system in accordance with claim 1 further comprising a holder for the specimen.

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11. The system in accordance with claim 10 wherein said holder comprises a vial having a top member, a bottom member, and a side wall member, and further wherein at least one of said top member, said bottom member, and said side wall member comprises a single crystalline material.

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12. The system in accordance with claim 11  
wherein the single crystalline material comprises a  
material selected from a group of materials consisting  
5 of Sapphire, Quartz, GaN, CaF<sub>2</sub>, Silicon, GaAs, and  
InP.

13. The system in accordance with claim 11  
wherein said bottom member comprises the single  
10 crystalline material, and wherein said lens is  
disposed proximate said bottom member.

14. The system in accordance with claim 13  
wherein the laser beam from said laser source passes  
15 through a first portion of said lens, the reflected  
light from said specimen passes through a second  
portion of said lens, and said first portion and said  
second portion are at off-set spatial locations from  
each other.

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15. The system in accordance with claim 11 wherein said side wall member comprises the single crystalline material.

5           16. A holder for a specimen of material for which a Raman signature is to be generated, the holder comprising:

          a vial having a top member, a bottom member, and a wall member,

10           at least one portion of at least one of said top member, said bottom member, and said side member comprising a single crystalline material.

15           17. The holder in accordance with claim 16 wherein the single crystalline material comprises a material selected from a group of materials consisting of Sapphire, Quartz, GaN,  $\text{CaF}_2$ , Silicon, GaAs, and InP.

20           18. The holder in accordance with claim 16 wherein said bottom member comprises the single crystalline material, said side member comprises

amorphous glass, and said bottom member is joined to the side member by melted amorphous glass.

19. A method for producing a Raman signature  
5 display, the method comprising the steps of:

operating a laser source to produce a laser beam;

directing the laser beam through a light guide  
from a first end thereof to a second end thereof and  
through a lens associated with the light guide;

10 directing the laser beam further onto a selected  
specimen from which light projected thereonto is  
reflected back to the lens associated with the light  
guide;

passing the reflected light back through the  
15 light guide from the second end thereof to the first  
end thereof;

dividing the reflected light at the second end of  
the light guide into a Raman signature portion and a  
second portion comprising a remainder of the reflected  
20 light;

directing the signature portion of the reflected  
light to an optical spectrum analyzer; and

operating the analyzer to provide a signature display.

20. A method for producing a Raman signature  
5 display, the method comprising the steps of:

placing a specimen for which a Raman signature is  
desired in a holder having at least one portion of one  
wall of a single crystalline material;

operating a laser source to produce a laser beam;

10 directing the laser beam through a light guide  
means and through a lens means associated with the  
light guide means;

directing the laser beam through the at least one  
portion of one wall of the holder and onto the  
15 specimen from which light projected thereonto is  
reflected back through the light guide means into an  
optical spectrum analyzer; and

operating the analyzer to provide a signature  
display.

20 21. A Raman spectroscopy optical probe assembly  
comprising:

a photonic crystal light guide for receiving a laser beam from a laser source and for directing the laser beam toward a specimen of selected material; and

5 a lens for receiving the laser beam in said light guide and directing the beam onto the specimen, and for receiving reflected light from the specimen and directing the reflected light back through said fiber light guide.